

## TITLE OF THE INVENTION

IMAGE PROCESSING APPARATUS, IMAGE PROCESSING METHOD AND  
RECORDING MEDIUM

5

## FIELD OF THE INVENTION

The present invention relates to an image  
processing apparatus having a sensor which  
photoelectric-converts light from an original or the  
10 like then accumulates the obtained signal and outputs  
the signal, and an image processing method for the  
apparatus.

## BACKGROUND OF THE INVENTION

15 An image processing apparatus which reads an  
original on a glass plate and sends image data to a host  
computer or the like is known. As the original, a  
document type original such as an article of magazine or  
the like, and a film type original such as a  
20 photographic film are used. In use of the former  
original, light reflected from the original is read, and  
in use of the latter original, light transmitted through  
the original is read. Image processings respectively  
characteristic of these original types are performed.

25 As the image sensor of the image processing  
apparatus, a line sensor such as a CCD is used.  
Especially, as a sensor for reading a color original, a

3-line color sensor with 3 arrays of line sensors,  
having color filters formed on photoelectric conversion  
devices, is often employed. In the image reading  
apparatus, two-dimensional image data is read by moving  
5 the above-described line sensor orthogonally to a  
direction along the array of photoreception devices.

Fig. 8 is a schematic view showing the structure  
of the CCD line sensor.

Numeral 802 denotes shift gates which are closed  
10 during a storage period. A photoreception device portion  
801 accumulates electric charge while performing  
photoelectric conversion during a photoreception period.  
When the shift gates 802 are opened, the accumulated  
electric charge is moved to shift registers 803. At this  
15 time, electric charge at odd-numbered photoreception  
devices and electric charge at even-numbered  
photoreception devices, in one line, are respectively  
moved to separate registers on both sides. The moved  
electric charge are transferred via the shift registers.

20 Fig. 9 is a timing chart showing a drive pulse and  
1-line data processing.

Symbol Hsync denotes a period required for moving  
the sensor in a subscanning direction to read one line  
of image, i.e., a period for image processing for one  
25 line in the system. Symbol SH denotes a signal supplied  
to the shift gates of the sensor. When the signal is at  
a LOW level, the shift gates are closed, on the other

hand, when the signal is at a HIGH level, the shift gates are open and accumulated electric charge is transferred to the shift registers. The period of the signal corresponds to the storage period of the line.

5 Numerals  $\phi 1$  and  $\phi 2$  denote drive signals for the shift registers. The transfer frequency of the pulses corresponds to the transfer speed. In this manner, all the pixels are transferred as image data within the storage period.

10 Generally, the image processing apparatus performs various image processings to obtain an ideal output image. Color balance adjustment performed upon color image reading is one of those processings. Generally, in the image sensor, the color balance is not completely  
15 adjusted among R, G and B of output signal due to influence of light source lamp and/or color filters.

Further, when a transmission-type original such as a positive film or a negative film is read by the same system, the color balance must be adjusted in  
20 consideration of film density or the like as well as the above factors. Especially, when a negative film is read, tonality must be adjusted for each original.

As to these requirements, gain control of analog signal, processing on AD-converted digital data and the  
25 like can be made. Further, a color sensor may be supplied with a shutter function to control exposure for each color. In this sensor, photoreception and storage

portions are connected to shutter drains. Pulses are supplied to shutter gates to arbitrarily control actual storage periods.

Fig. 10 is a timing chart showing a driving method for the color sensor with the shutter function.

Storage periods SH\_R, SH\_G and SH\_B of 3 color photoreception portions are the same, however, drive signals supplied to shutter gates are different for respective colors. When these signals are at a HIGH level, the gates are opened and electric charge is discharged to the shutter drains, while when the signals are at a LOW level, storage is started. In this manner, the actual electric-charge storage period can be changed for respective colors while synchronizing the 3 color lines. However, this function added to the sensor increases the costs, and further, widens the distance between the lines.

#### SUMMARY OF THE INVENTION

The present invention provides image processing apparatus and method which control storage period for respective colors without any particular function such as electronic shutters on the sensor side, and arbitrarily set storage periods without consideration of blooming or the limit of hardware processing speed in the subsequent stage.

To solve the above-described problem and attain

the foregoing object, according to a first aspect of the present invention, the image processing apparatus has the following construction.

That is, provided is an image processing apparatus  
5 comprising: a line sensor which photoelectric-converts light into a signal then accumulates the signal, and outputs the signal as a 1-line electric signal; and a drive circuit which drives the line sensor such that one line period is divided into a first section for reading  
10 valid image data, a second section for storing dummy image data, and a third section for storing valid image data.

Further, according to a second aspect of the present invention, the image processing apparatus has  
15 the following construction.

That is, provided is an image processing apparatus comprising: plural photoreception storage portions which respectively perform photoelectric conversion and accumulate different color signals; and drive circuit  
20 which starts storage of new signal by reading signals accumulated in the photoreception storage portions, and sets storage periods for respective colors by changing timings of reading signals from the photoreception storage portions for the respective colors.

25 Further, according to a third aspect of the present invention, the image processing method has the following construction.

That is, provided is an image processing method comprising the steps of: photoelectric-converting light into a signal then accumulates the signal, and outputting the signal as a 1-line electric signal, by a  
5 line sensor; and driving the line sensor such that one line period is divided into a first section for reading valid image data, a second section for storing dummy image data, and a third section for storing the valid image data.

10 Further, according to a fourth aspect of the present invention, the image processing method has the following construction.

That is, provided is an image processing method for an image processing apparatus having plural  
15 photoreception storage portions which respectively perform photoelectric conversion and accumulate different color signals, wherein storage of new signal is started by reading signals accumulated in the photoreception storage portions, and storage periods are  
20 set for respective colors by changing timings of reading signals from the photoreception storage portions for the respective colors.

Further, a control program of the present invention has the following construction.

25 That is, the above image processing method is executed by a computer.

Further, a recording medium of the present

invention has the following construction.

That is, the above control program is accumulated in a computer-readable recording medium.

Other objects and advantages besides those  
5 discussed above shall be apparent to those skilled in  
the art from the description of a preferred embodiment  
of the invention which follows. In the description,  
reference is made to accompanying drawings, which form a  
part thereof, and which illustrate an example of the  
10 invention. Such example, however, is not exhaustive of  
the various embodiments of the invention, and therefore  
reference is made to the claims which follow the  
description for determining the scope of the invention.

#### 15 BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated  
in and constitute a part of the specification,  
illustrate embodiments of the invention and, together  
with the description, serve to explain the principles of  
20 the invention.

Fig. 1 is a cross-sectional view of an image  
processing apparatus main body according to the present  
invention;

Fig. 2 is a block diagram of the image processing  
25 apparatus;

Fig. 3 is a schematic view of the inside of a 3-  
line color line sensor;

Fig. 4 is a timing chart explaining a driving method for the line sensor;

Fig. 5 is a timing chart showing signals  $\phi 1$ ,  $\phi 2$ , RS and CP during a reading section;

5 Fig. 6 is a timing chart showing signals in a dummy section and a storage section;

Fig. 7 is a timing chart showing a driving method for the image processing apparatus according to a third embodiment of the present invention;

10 Fig. 8 is a schematic view of the structure of the conventional line sensor;

Fig. 9 is a timing chart showing the drive pulse and 1-line data processing in the conventional line sensor; and

15 Fig. 10 is a timing chart showing the driving method for the color sensor with shutter function.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

20 Preferred embodiments of the present invention will now be described in detail in accordance with the accompanying drawings.

<First Embodiment>

Fig. 1 is a cross-sectional view of an image  
25 processing apparatus main body according to the present embodiment, cut at the center of a lens 108.

Numerals 101 denotes an image processing apparatus



to read an original placed on a platen glass 102, by scanning, convert the read image information into digital information, and send the image information to a computer; 103, a first mirror which scan-reads the  
5 original placed on the platen glass 102 of the image processing apparatus 101; 104, a second mirror which moves at a speed  $1/2$  of that of the first mirror 103; 105, a fluorescent lamp which irradiates the original; 106, a reflector which collects light from the lamp to a  
10 reading position; 107, a carriage to which the lamp, the first mirror, the reflector and the like are fixed; 108, a image formation lens; and 109, a line sensor which converts the optical image information into an electric signal. As the first mirror 103 and the second mirror  
15 104 move at speeds in the ratio of 1:0.5, a constant optical distance is maintained between the original on the platen glass 102 and the line sensor 109.

Fig. 2 is a block diagram of the image processing apparatus.

20 A lamp inverter 209 turns on a fluorescent lamp 201 based on a light-source ON/OFF control signal from a CPU 210. The light from the light source irradiates the original, and further, reflected light from the original enters the image sensor 203 through a image forming lens  
25 202. The image sensor photoelectric-converts the reflected light and outputs an electric signal to an analog circuit 204. The analog circuit 204 performs

analog processing such as amplification on the image  
signal from the sensor, and sends the signal to the A/D  
converter 205. The A/D converter 205 converts the analog  
signal received from the analog circuit 204 to a digital  
5 signal and outputs the signal to a digital circuit 207.  
Numeral 206 denotes a memory for temporarily storing  
shading data and work data for the CPU 210. In a digital  
processing block, necessary processing is performed on  
the digital image signal outputted from the A/D  
10 converter 205, and the data is sent to a subsequent-  
stage interface circuit 208. The interface circuit 208  
transmits the processed image data to a host computer  
211 in correspondence with a communication protocol. A  
drive circuit 212 outputs various pulses necessary for  
15 driving the image sensor 203, thereby controls the image  
sensor. The CPU 210 controls the digital circuit 207,  
the interface circuit 208, the lamp inverter 209, the  
drive circuit 212 and the like.

Fig. 3 is a schematic view of the inside of 3-line  
20 color line sensor.

Numeral 301 denotes a photoreception storage  
portion of the color line sensor which photoelectric-  
converts light received by photodiodes and stores  
electric charge; 302, a shift gate which is closed while  
25 the electric charge is accumulated, and opened when the  
electric charge accumulated in the storage portion is  
moved to a transfer register; and 303, the transfer

register which transfers the electric charge moved from the storage portion to an output stage, pixel by pixel. In this embodiment, two signals  $\phi 1$  and  $\phi 2$  are alternately inputted into the transfer register. The electric charge  
5 is transferred by the signals of mutually opposite phases. Numeral 304 denotes a capacitor temporarily storing the electric charge, which resets the electric charge by a reset pulse (RS). Numeral 305 denotes a clamp circuit with a voltage clamped by a clamp pulse  
10 (CP) to a reference voltage. The transferred electric charge is outputted as image data electric signal through an output buffer.

Note that a red color filter is provided in the photoreception storage portion 301 of the line sensor  
15 300a, a green color filter is provided in the photoreception storage portion 301 of the line sensor 300b, and a blue color filter is provided in the photoreception accumulation portion 301 of the line sensor 300c, respectively for storing and transmitting  
20 different color signals.

Fig. 4 is a timing chart for explaining a driving method for the line sensor controlled by a drive circuit, showing processing in 1-line period. Symbol Hsync denotes a horizontal synchronizing signal of a period  
25 required for reading one image line during which the sensor moves for one line in the subscanning direction. Symbols SH\_R, SH\_G and SH\_B denote signals respectively

supplied to the shift gates of the sensor. When the signals are at a LOW level, the shift gates are closed, and when the signals are at a HIGH level, the shift gate is opened, and the electric charge in the accumulation  
5 portion is transferred to the transfer resisters.

Symbols  $\phi 1$  and  $\phi 2$  denote drive signals for the transfer register. The electric charge in the transfer register is transferred in correspondence with frequencies of these signals.

10 In Fig. 4, the period for one line is divided into three sections. First, immediately after the first section Hsync, valid image data is read out. All the shift gates of three line sensors 300a, 300b and 300c are opened with the Hsync, and electric charge  
15 accumulated in a previous line accumulation section is transferred, and processed as valid image data. In the previous line, different accumulation periods are set for the respective colors. The second section is provided for reading the electric charge accumulated in  
20 the photoreception accumulation portion 301 in the first section (B in Fig. 4), and for storing dummy electric charge for setting the third section to be described later to periods for the respective colors. That is, the timing of transferring dummy electric charge from the  
25 photoreception accumulation portion 301 to the transfer register 303 is shifted for the respective colors. In the third section, the accumulation periods are changed

in accordance with settings. The accumulation data in this section are processed in the next line. Further, in the third section, the dummy electric charge accumulated in the second section is read (in Fig. 4, C indicates a pulse for reading the dummy electric charge from the line sensor 300a; D, a pulse for reading the dummy electric charge from the line sensor 300b; and E, a pulse for reading the dummy electric charge from the line sensor 300c). In this manner, one line, divided into a section for electric charge accumulation and sections for data reading, can be easily controlled. Further, signals to drive the sensor in the reading section is different from that in the other sections.

Fig. 5 shows the signals  $\phi 1$ ,  $\phi 2$ , RS and CP in the reading section. Fig. 6 shows the signals in the dummy section and the accumulation section. In the present embodiment, in Fig. 6, the electric charge in the register is transferred at a speed 4 times that in Fig. 5. In this manner, in the sections other than the reading section, the electric charge is transferred at a high speed, thereby all the electric charge can be sent even if the electric charge accumulated in the accumulation period overflows the transfer register 203.

As described above, according to the present embodiment, the complicated 1-line processing in the line sensor 109 is easily and reliably realized by a simple method. Further, the accumulation periods can be

controlled for respective colors without providing any particular function such as electronic shutters on the line sensor side. Further, the accumulation periods can be freely set for the respective colors without

- 5 consideration of blooming and/or the limit of hardware processing speed in the subsequent stage.

<Second Embodiment>

- 10 In the above-described first embodiment, one line period is divided into three sections having independent functions, thereby the accumulation periods can be controlled for the respective colors. Further, the sensor drive signals used in the valid data reading section are different from those in other sections. In
- 15 Fig. 4, the period of dummy section "B" is much shorter than that of reading section "A". In the present embodiment, the transfer frequency of the sensor for electric charge transfer is increased such that a product of the duration of the dummy section and the
- 20 transfer frequency of the section is greater than the product of the duration of the reading section and the transfer frequency of the section, i.e., the number of cycles of the dummy section is greater than that of the reading section.

- 25 In this arrangement, in addition to the advantages in the first embodiment, obtained is an advantage that even if a short dummy section is set, all the electric

charge in the register can be transferred.

<Third Embodiment>

Fig. 7 is a timing chart showing the driving  
5 method for the image processing apparatus according to a  
third embodiment of the present invention.

In this embodiment, the SH pulses (SH\_R, SH\_G and  
SH\_B) are periodically applied during the dummy section,  
so as to periodically read the accumulated electric  
10 charge.

In this arrangement, in addition to the advantages  
in the first embodiment, obtained is an advantage that  
the accumulation period of the dummy section can be  
prevented from becoming extremely long.

Note that the present invention also includes a  
15 case where, to operate various devices to realize the  
functions according to the embodiments, software program  
code is provided to a computer in an apparatus or a  
system connected to the various devices, and the  
20 computer of the system or apparatus (CPU or MPU)  
operates in accordance with the accumulated program.

In this case, the above software program code  
itself realizes the functions according to the above-  
described embodiments, and the program code itself, and  
25 means for providing the program code to the computer,  
e.g., an accumulation medium storing the program code,  
constitute the invention. As the accumulation medium

storing the program code, a floppy disk, a hard disk, an optical disk, a magneto-optical disk, a CD-ROM, a magnetic tape, a non-volatile type memory card, a ROM and the like can be used.

5           Furthermore, besides aforesaid functions according to the above embodiments are realized by executing the program code which is read by a computer, the present invention includes a case where an OS (operating system) or the like working on the computer performs a part or  
10   entire processes in accordance with designations of the program code and realizes functions according to the above embodiments.

          Furthermore, the present invention also includes a case where, after the program code read from the  
15   accumulation medium is written in a function expansion card which is inserted into the computer or in a memory provided in a function expansion unit which is connected to the computer, a CPU or the like contained in the function expansion card or unit performs a part or  
20   entire process in accordance with designations of the program code and realizes functions of the above embodiments.

          In the image processing apparatus according to the present embodiment, in the first section, valid image  
25   data is read, in the third section, the electric charge accumulation periods are variable for the respective colors, and in the second section as a dummy section,



the function of the third section is complemented. In this manner, as one line period is divided into first to third sections having different functions, the line sensor can be easily controlled, and valid electric charge accumulation period can be easily controlled for the respective colors without providing any particular mechanism such as shutters to the image sensor.

Further, as the transfer frequency for electric charge transfer in the first section is different from that in the second and third sections, unnecessary electric charge can be idle-transferred during a short accumulation period by selecting a line sensor drive pulse for a normal reading mode or a pulse for a high-speed mode only for transfer from the register, in one line.

Further, as the second section as a dummy section has a part where accumulated electric charge is periodically read out, electric charge remaining in the photo diodes can be removed.

In the above-described embodiments, the accumulation periods can be easily and reliably controlled for the respective colors by a simple method, and the freedom of color matching design can be increased in the entire image processing apparatus. Further, the lengths of the accumulation periods can be freely set for the respective colors without consideration of blooming and/or the limit of hardware

processing speed in the subsequent stage.

The present invention is not limited to the above embodiments and various changes and modifications can be made within the spirit and scope of the present

5 invention. Therefore, to appraise the public of the scope of the present invention, the following claims are made.